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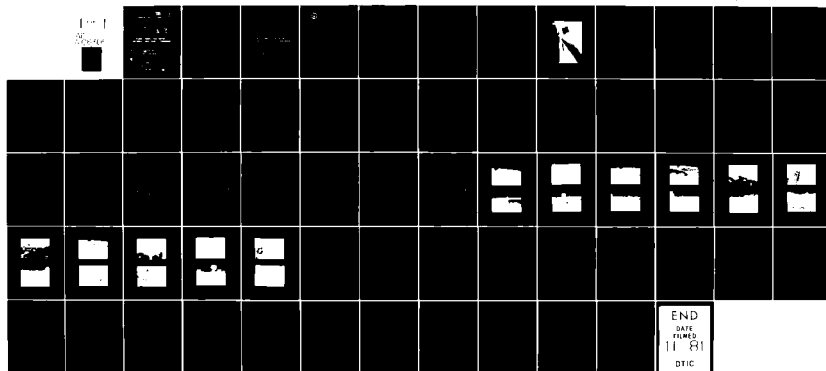
BLACK AND VEATCH KANSAS CITY MO

NATIONAL DAM SAFETY PROGRAM. LAKE LAFAYETTE DAM (MO 20415), MIS--ETC (11)  
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**MISSOURI-KANSAS CITY BASIN**

**AD A106305**

**LAKE LARWETTE DAM**

**LARWETTE COUNTY, MISSOURI**

**NO 20415**

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**PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM**

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**United States Army  
Corps of Engineers  
Serving the Army  
Serving the Nation**

**St. Louis District**

**PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS**

**FOR: STATE OF MISSOURI**

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Dam Inspection Report National Dam Safety Program Lake Lafayette Dam (MO 20415) Lafayette County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report
6. AUTHOR(s) S. Veatch, Consulting Engineers		7. PERFORMING ORG. REPORT NUMBER
8. PERFORMING ORGANIZATION NAME AND ADDRESS Army Engineer District, St. Louis Inventory and Inspection Section, LMSFD-PI Tucker Blvd., North, St. Louis, Mo. 63101		9. CONTRACT OR GRANT NUMBER(s) DACH 43-80-0-0074
10. CONTROLLING OFFICE NAME AND ADDRESS Army Engineer District, St. Louis Inventory and Inspection Section, LMSFD-PI Tucker Blvd., North, St. Louis, Mo. 63101		11. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 12
12. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 10 Paul R. /Zaman Edwin R. /Burton Harry L. /Callahan		13. REPORT DATE June-1963
		14. NUMBER OF PAGES Approximately 70
		15. SECURITY CLASS (of this report) UNCLASSIFIED
		16. DECLASSIFICATION DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of this Report) Approved for release; distribution unlimited.		
18. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 6 National Dam Safety Program, Lake Lafayette Dam (MO 20415), Missouri - Kansas City Basin, Lafayette County, Missouri. Phase I Inspection Report.		
19. SUPPLEMENTARY NOTES		
20. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
21. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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# **MISSOURI-KANSAS CITY BASIN**

**LAKE LAFAYETTE DAM**

**LAFAYETTE COUNTY, MISSOURI**

**MO 20415**

## **PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM**



**United States Army  
Corps of Engineers**  
Serving the Army  
Serving the Nation

**St. Louis District**

**PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS**

**FOR: STATE OF MISSOURI**

**JUNE 1980**



OFFICE OF  
ENGINEERING

**DEPARTMENT OF THE ARMY**

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

210 TUCKER BOULEVARD, NORTH

ST. LOUIS, MISSOURI 63101

**SUBJECT: Lake Lafayette Dam, Mo. ID No. 20415**

**Phase I Inspection Report**

This report presents the results of field inspection and evaluation of the Lake Lafayette Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

**SIGNED**

**SUBMITTED BY:**

Chief, Engineering Division

**25 SEP 1960**

Date

**SIGNED**

**APPROVED BY :**

Colonel, CE, District Engineer

**40 SEP 1960**

Date

LAKE LAFAYETTE DAM  
LAFAYETTE COUNTY, MISSOURI  
MISSOURI INVENTORY NO. 20415

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH  
CONSULTING ENGINEERS  
KANSAS CITY, MISSOURI

UNDER DIRECTION OF  
ST. LOUIS DISTRICT CORPS OF ENGINEERS  
FOR  
GOVERNOR OF MISSOURI

JUNE 1980

## PHASE I REPORT

### NATIONAL DAM SAFETY PROGRAM

Name of Dam	Lake Lafayette Dam
State Located	Missouri
County Located	Lafayette County
Stream	Tributary to the East Fork of Sni-A-Bar Creek
Date of Inspection	12 June 1980

Lake Lafayette Dam was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

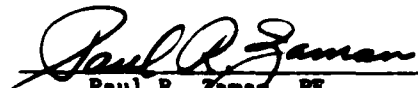
The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers, failure would threaten lives and property. The estimated damage zone extends approximately three miles downstream of the dam. Within the estimated damage zone are four dwellings, seven barns, and a trailer. Contents of the estimated damage zone were verified by the inspection team.


Our inspection and evaluation indicates the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will not pass the probable maximum flood without overtopping but will pass 50 percent of the probable maximum flood, and will pass the one percent chance flood (100-year flood). The spillway design flood recommended by the guidelines is the probable maximum flood. The probable maximum flood is defined as the flood discharge which may be expected from the most severe combination of critical meteorologic and hydrologic conditions which are reasonably possible in the region.

Based on visual observations, this dam appears to be in good condition. Deficiencies visually observed by the inspection team were an

area of seepage downstream of the dam, seepage from the left abutment-embankment interface, erosion of the upstream slope at the beach area, an erosion gully at the downstream slope-left abutment interface, animal burrows on the embankment, and one large tree growing on the embankment. Seepage and stability analyses required by the guidelines were not available.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, as required by the guidelines, should be performed. A detailed report discussing each of these deficiencies is attached.

  
Paul R. Zaman, PE  
Illinois 62-29261

  
Edwin R. Burton, PE  
Missouri E-10137

  
Harry L. Callahan, Partner  
Black & Veatch





OVERVIEW OF DAM

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
LAKE LAFAYETTE DAM

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Appendix A - Hydrologic and Hydraulic Analyses

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## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the Lake Lafayette Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

### 1.2 DESCRIPTION OF PROJECT

#### a. Description of Dam and Appurtenances.

(1) The dam is an earth structure located in the valley of a tributary to the East Fork of Sni-A-Bar Creek (Plate 1). The watershed is an area of low hills of which 60% is lake development property. The lake development property consists of houses, trailers, grassland, timber, and gravel roads (Plate 2). The dam is approximately 860 feet long along the crest and 48 feet high. The dam crest is 29 feet wide with a gravel road across the top. A parking area lies near the center of the embankment on the downstream slope. The road forms a circular drive on the upstream slope. A beach area is located near the right end (looking downstream) of the embankment. A bathhouse exists on the embankment crest adjacent to the beach area. The back face of the dam slopes from the crest to the valley floor below except where fill has been placed on the slope to form the parking area.

(2) The principal spillway from the lake is an uncontrolled 48-inch, square concrete drop inlet connected to a 36-inch corrugated metal pipe installed in the embankment. The drop inlet is about 4 feet deep with a sloping steel trash rack made up of 1-inch steel bars with 4-inch clear openings. The outlet end of the principal spillway pipe is a concrete structure consisting of a vertical headwall, sloping wingwalls and apron.

Flow through the pipe discharges into the natural stream channel below. The emergency spillway consists of a trapezoidal cut through the right abutment with a concrete control sill. Discharge through the emergency spillway flows over an overfall approximately 200 feet downstream of the control sill to a plunge pool in the natural channel.

(3) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in Lafayette County, Missouri as indicated on Plate 1. The lake formed by the dam is in an area shown on the United States Geological Survey 7.5 minute series quadrangle map for Odessa South, Missouri in Section 23 of T48N, R28W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the intermediate size category.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: Lake Lafayette Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For Lake Lafayette Dam the estimated flood damage zone extends approximately three miles downstream of the dam. Within the estimated damage zone are four dwellings, seven barns, and a trailer. Contents of the estimated damage zone were verified by the inspection team.

e. Ownership. The dam is owned by the Lafayette Land Company, Inc., P.O. Box 217, Odessa, Missouri, 64076, Telephone 816-229-7900.

f. Purpose of Dam. The dam forms a 74 acre lake used for recreation.

g. Design and Construction History. The dam was designed by Kenney Engineers, Inc., 3367 Tates Creek Pike, Lexington, Kentucky, 40502. The dam was constructed in 1972 by Sowers Construction Company, Waverly, Missouri, 64096.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, evaporation, and overflow through the uncontrolled outlet pipe and emergency spillway all combine to maintain a relatively stable water surface elevation.

### 1.3 PERTINENT DATA

a. Drainage Area - 1.71 square miles.

b. Discharge at Damsite.

(1) Normal discharge at the damsite is through an uncontrolled 48-inch, square concrete drop inlet connected to a 36-inch outlet pipe.

(2) Estimated experienced maximum flood at damsite - Unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation 4,500 cfs (Probable Maximum Flood Pool El. 859.4).

c. Elevation (Feet above m.s.l.).

(1) Top of dam - 857.1 (see Plate 3)

(2) Emergency spillway crest - 850.4

(3) Principal spillway crest - 850.0

(4) Streambed at toe of dam - 809  $\pm$  (approximated from design drawings)

(5) Maximum tailwater - Unknown.

d. Reservoir.

(1) Length of maximum pool - 5,400 feet  $\pm$  (Probable maximum flood pool level)

(2) Length of normal pool - 4,950 feet  $\pm$  (Principal spillway crest)

e. Storage (Acre-feet).

(1) Top of dam - 1,170

(2) Emergency spillway crest - 1,072

(3) Principal spillway crest - 1,040

(4) Design surcharge - Not available.

f. Reservoir Surface (Acres).

- (1) Top of dam - 104
- (2) Emergency spillway crest - 76
- (3) Principal spillway crest - 74.3

g. Dam.

- (1) Type - Earth embankment
- (2) Length - 860 feet
- (3) Height - 48 feet  $\pm$
- (4) Top width - 29 feet
- (5) Side slopes - near the beach the upstream face varies from 1.0 V on 9.2 H to 1.0 V on 11.1 H, downstream face varies from 1.0 V on 5.0 H to 1.0 V on 10.9 H (see Plate 4); for the remainder of the dam the upstream face and the downstream face are 1.0 V to 2.5 H (see Plate 5).
- (6) Zoning - Unknown.
- (7) Impervious clay core - 10' top width at Elev. 850 with 1.0 V to 1.0 H upstream and downstream slopes (see Plate 5).
- (8) Cutoff trench - 8' bottom width with 1.0 V to 1.0 H side slopes, bottom Elev. 800 (see Plate 5).
- (9) Grout curtain - None.

h. Diversion and Regulating Tunnel - None.

i. Principal Spillway.

- (1) Type - 48-inch square concrete drop inlet connected to a 36-inch corrugated metal outlet pipe.
- (2) Inlet crest elevation - 850.0 feet m.s.l.
- (3) Outlet invert elevation 839.6 feet m.s.l.
- (4) Gates - None.



(5) Upstream channel - Not applicable.

(6) Downstream channel - Natural open channel to streambed.

j. Emergency Spillway.

(1) Type - Unlined in soil and rock with a concrete control sill.

(2) Width of channel - 68 feet.

(3) Emergency spillway crest - 850.4

(4) Gates - None.

(5) Upstream channel - Grass lined to the concrete control sill.

(6) Downstream channel - Unlined soil over limestone in the channel downstream of the concrete control sill to an overfall of exposed limestone and shale to the plunge pool in the natural channel.

k. Regulating Outlets.

(1) Type - 24 inch cast iron pipe through embankment (shown on preliminary design drawings).

(2) Inlet elevation - 813.0 feet m.s.l.

(3) Outlet invert elevation - 808.0 feet m.s.l.

(4) Gates - 24 inch valve at downstream toe of dam.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

Design data in the form of preliminary design drawings and specifications were made available by the owner, the Lafayette Land Company, Inc.

### 2.2 CONSTRUCTION

Construction records were unavailable, however, the dam was constructed in 1972 by Sowers Construction Company, Waverly, Missouri 64096.

### 2.3 OPERATION

Documentation of past floods was not available.

### 2.4 GEOLOGY

The site of the dam and reservoir is located in a deeply dissected valley between two ridges. The dam impounds an intermittent tributary of the East Fork of Sni-A-Bar Creek.

The soils in the area of the dam and reservoir consist of the Sogn, Sampsel, Winfield, Minden, Macksburg, Higginsville, Polo and Kennebec soil series. The Sogn and Sampsel soils occur along the slopes of the reservoir. They are formed in residuum from limestone, shale and sandstone. They are classified for engineering purposes as low or high-plastic clays (CL or CH). The Winfield, Minden, Macksburg, Higginsville, and Polo soils occur on the uplands around the reservoir. They are formed in loess overlying shale, limestone or sandstone bedrock. They are classified for engineering purposes as low-plastic silt (ML) or low-plastic clay (CL). The Kennebec soils are located downstream from the embankment and are formed in alluvium along the floodplain. These soils are classified for engineering purposes as low-plastic silt (ML) or low-plastic clay (CL).

The bedrock in the area of the dam and reservoir consists of sandstone and shale of the Marmaton Group.

### 2.5 EVALUATION

a. Availability. Limited engineering data was obtained from the owner in the form of preliminary design drawings and contract specifications.

b. Adequacy. Engineering data made available were inadequate for making a detailed assessment of the design, construction, and operation.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The validity of the design, construction, and operation could not be determined due to the inadequacy of engineering data. The 24 inch drain valve shown on preliminary design drawings was not found by the inspection team. The principal spillway observed was not shown on the preliminary design drawings.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

a. General. A visual inspection of Lake Lafayette Dam was made on 12 June 1980. The inspection team consisted of Ed Burton, team leader; Bob Pinker, geologist; Gary Van Riessen, geotechnical engineer; Andy Dywan, civil engineer, John Ruhl, hydrologist; and Russ Burnham, structural engineer. The dam is in good condition. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following conditions at the dam. No cracks, sloughing or other signs of settlement were observed. There was no evidence that the dam had ever been overtopped. The embankment has no visible stability problems. No instruments to measure the performance of the dam were located.

Seepage was observed downstream of the dam and on the left abutment. The non-measurable flow of clear seepage was observed coming from the natural material below the recreation area parking lot located downstream of the dam and from the natural formation at the interface of the toe of the embankment and the left abutment. Another area of seepage was located near a plastic pipe drain on the right side of the principal spillway outlet pipe which is probably a part of the septic tank sanitary system for the bathhouse. No toe drains or relief wells were observed.

The gravel road on the dam crest is well maintained. A good stand of unmowed fescue grass exists on the upstream and downstream slopes. There is one large tree on the embankment near the emergency spillway. Some riprap and small stone was evident on the berm on the upstream face at the water level. On the right side of the dam in the beach area, a vertical face has developed in the unprotected upstream slope. Some erosion was also observed on the downstream slope. This erosion appears to be under control and probably occurred from runoff before the grass cover was established. An erosion gully at the left abutment-embankment interface was also observed.

A few small animal burrows were observed on the embankment. An area of excavation approximately 60 feet wide by 175 feet long has been cut into the natural material at the downstream toe of the embankment between the emergency and principal spillways. The cut forms a 5-foot vertical face. The purpose of this excavation is unknown.

c. Appurtenant Structures. The inspection team observed the following items pertaining to appurtenant structures. The inside of the

principal spillway pipe at each end, the headwall at the outlet end, and the top of the drop inlet were observed. The pipe has settled at the dam centerline but the amount could not be measured. The asphalt coating on the inside of the pipe was badly worn at the downstream end. There was no evidence of leakage into, out of or around the spillway pipe. The pipe joints could not be observed. Some backfill material was recently placed around the concrete outlet structure, probably to replace material eroded by surface runoff. The emergency spillway, which is in good condition, consists of a trapezoidal channel cut through the right abutment with a concrete control sill. The concrete control sill is located about 100-feet downstream from the channel entrance and at the centerline of the dam. The control sill is 2-feet wide, 3 feet thick and extends some 60 feet across the channel invert with side slopes of 2 horizontal to 1 vertical rising to a height of 6 feet. The concrete in the control sill was observed to be in good condition. The channel below the control sill is composed of soil over limestone. It then extends to an overfall of exposed limestone, shale and sandstone, and finally to a plunge pool in the natural channel.

Erosion was observed in the emergency spillway channel bottom and around the control sill which had been recently regraded. Some large limestone boulders have been placed just downstream of the control sill for channel protection. The emergency spillway contains no obstructions to flow. An abnormally large spillway discharge should not erode the embankment.

The 24 inch drain pipe and valve shown on preliminary design drawings was not found by the inspection team.

d. Geology. The soil in the area of the dam and reservoir consisted of soil formed in loess, alluvium, and residuum from sandstone, shale, and limestone. The soils formed in loess covered the uplands; the soils formed in alluvium were along the valley downstream of the dam, and the soils formed in residuum were located along the slopes of the reservoir and the left abutment of the dam.

Rock outcrops were observed along the abutments of the dam and in the spillway. The outcrop in the right abutment consisted of inter-bedded sandstone and shale that is weathered to varying degrees. The outcrops in the spillway consisted of limestone, sandstone and shale. The limestone and sandstone ledges were displaced where water had eroded the underlying shales. Two sets of closely-spaced vertical joints normal to each other were observed in the strata.

Samples of the embankment were taken near the center of the upstream crest using an Oakfield sampler. The materials were classified as low-plastic silt (ML) and low-plastic clay (CL). Based on these samples and visual observations, it is anticipated that the embankment consists of clayey silt and silty clay.

The abutments of the dam consist of interbedded limestone shale and sandstones of the Marmaton Group. The foundation is anticipated to consist of shale of the Marmaton Group. No boring information was available for the dam.

e. Reservoir Area. The only area of erosion along the shore of the lake was in the beach area. There was no noticeable lake siltation nor were there any slides of the reservoir banks.

f. Downstream Channel. The channel downstream of the spillway outlet pipe is a natural open channel to the original streambed.

### 3.2 EVALUATION

The various deficiencies observed at the time of the inspection are not believed to represent an immediate safety hazard. They do, however, warrant monitoring and control. The seepage areas observed below the dam and from the left abutment should be monitored regularly for quality and quantity. Seepage can cause internal erosion creating cavities and underground channels. Ultimately, seepage can lead to piping failure of the embankment and/or abutment material. The erosion of the upstream slope in the beach recreation area will be a continuing maintenance problem since most slope protection would be incompatible with the use of the area as a beach. The use of soil cement slope protection, after the present vertical face has been backfilled, compacted and regraded, would be a suitable base for the beach sand. The erosion observed on the downstream slope, at the principal spillway outlet and in the emergency spillway channel has recently been repaired and appears to be under control. The one large tree near the emergency spillway was growing in natural material. However, due to its nearness to the embankment and emergency spillway, its roots could cause deterioration of the embankment. The presence of burrowing animals is not presently a serious problem; however, if allowed to go unchecked, the population of animals will increase. Burrowing animals can cause damage to the embankment. The open excavation between the principal and emergency spillways is cut into natural material at the toe of the embankment. Since the embankment at this location is wide with flat slopes and very little height, the excavation is not likely to create a stability problem.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

The pool is primarily controlled by rainfall, runoff, evaporation, transpiration, and capacity of the uncontrolled principal spillway outlet pipe and emergency spillway.

### 4.2 MAINTENANCE OF DAM

The dam was inspected by the Missouri Geology and Land Survey Department on 18 April 1979. The existing maintenance program includes mowing the grass on the shoulders of the crest roadway and around the recreation areas, but the slopes show no evidence of mowing. Recent repair work of areas with erosion has taken place on the downstream slope, in the emergency spillway channel and adjacent to the principal spillway outlet headwall.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities were found.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no existing warning system or preplanned scheme for alerting downstream residents for this dam.

### 4.5 EVALUATION

The maintenance program should be expanded to include mowing the grass cover on the embankment in order to discourage animal burrowing. The backfill and grading work in and around the spillways should be checked during the periods of discharge to see if the corrective measures perform satisfactorily. The areas of seepage should be monitored periodically and, if flows increase significantly or if seepage flows become muddy, a qualified engineer should be consulted.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

a. Design Data. Design data pertaining to hydrology and hydraulics were unavailable.

b. Experience Data. The drainage area and lake surface area are developed from USGS Odessa South Quadrangle Map. The dam and spillway layout is from a survey made during the inspection and from preliminary design drawings.

c. Visual Observations.

(1) The principal spillway appears to be in good condition except for a slight settlement near the center of the dam. The lake level at the time of the inspection was below the inlet level and there was no flow through the pipe. Only the inlet and outlet ends, the drop inlet, and the pipe alignment were observable. The spillway pipe discharges into an open channel which overfalls to the natural stream. There were no obstructions to flow in the downstream channel.

(2) The emergency spillway channel is in good condition. The erosion in the channel appears to have been repaired satisfactorily.

(3) Spillway discharges do not endanger the integrity of the dam.

d. Overtopping Potential. The spillway will not pass the probable maximum flood without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway will pass 50 percent of the probable maximum flood without overtopping the dam and will also pass the one percent chance flood estimated to have a peak outflow of 710 cfs developed by a 24-hour rainfall. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of intermediate size should pass the probable maximum flood. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 5,240 cfs of the total discharge from the reservoir of 9,740 cfs. The estimated duration of overtopping is 3.2 hours with a maximum depth over the dam of 2.3 feet. Overtopping for this period of time could jeopardize the embankment.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately three miles down-



stream of the dam. Four dwellings, seven barns, and one trailer could be severely damaged and lives could be lost should failure of the dam occur. Contents of the estimated damage zone were verified by the inspection team. There does not appear to be any floodplain regulations or other constraints in force to limit future downstream development.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design data relating to the structural stability of the dam were found. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. No operational records exist.

d. Postconstruction Changes. Grading was evident in the emergency spillway to control erosion. An area of excavation is located between the principal and emergency spillways. The purpose of this excavation is unknown.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone. The seismic stability of an earth dam is dependent upon a number of factors: embankment and foundation material classifications and shear strengths; abutment materials, conditions, and strengths; embankment zoning; and embankment geometry.

Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

a. Safety. Several conditions observed during the visual inspection by the inspection team should be monitored and/or controlled. These are erosion of the upstream face of the embankment in the beach area, the erosion gully at the left abutment-embankment interface, seepage from the left abutment, a seepage area below the dam, the tree, and animal burrows on the embankment. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

b. Adequacy of Information. Due to the inadequacy of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2b should be accomplished in the near future.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam nor does it identify any serious dangers which would require a Phase II investigation. However, the additional analyses noted in paragraph 2.5b are necessary for compliance with the guidelines.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the recommended stability analysis.

### 7.2 REMEDIAL MEASURES

a. Alternatives. The emergency spillway size and/or height of the dam would need to be increased or the lake level would need to be lowered to increase available flood storage in order to pass the spillway design flood. The emergency spillway should be protected to prevent erosion.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended and should be carried out under the direction of a professional engineer experienced in the design, construction, and maintenance of earth dams.

(1) Soil cement or other suitable slope protection should be placed on the upstream face of the dam in the beach area to prevent erosion of the embankment material.

(2) The seepage areas noted during the visual inspection should be closely monitored and documented as to quantity and quality of flow. Any significant changes should be evaluated.

(3) The erosion gully at the left abutment-embankment interface should be repaired. The embankment slope should be monitored during this repair.

(4) The maintenance program should continue to remove and control the growth of brush and trees on the embankment. Grass cover on the embankments should be cut periodically. The one large tree near the emergency spillway should be removed.

(5) The animal burrows on the embankment should be repaired and a program to control animal activity in the area should be established.

(6) Seepage and stability analyses should be performed.

(7) A detailed inspection of the dam should be made periodically. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increase.

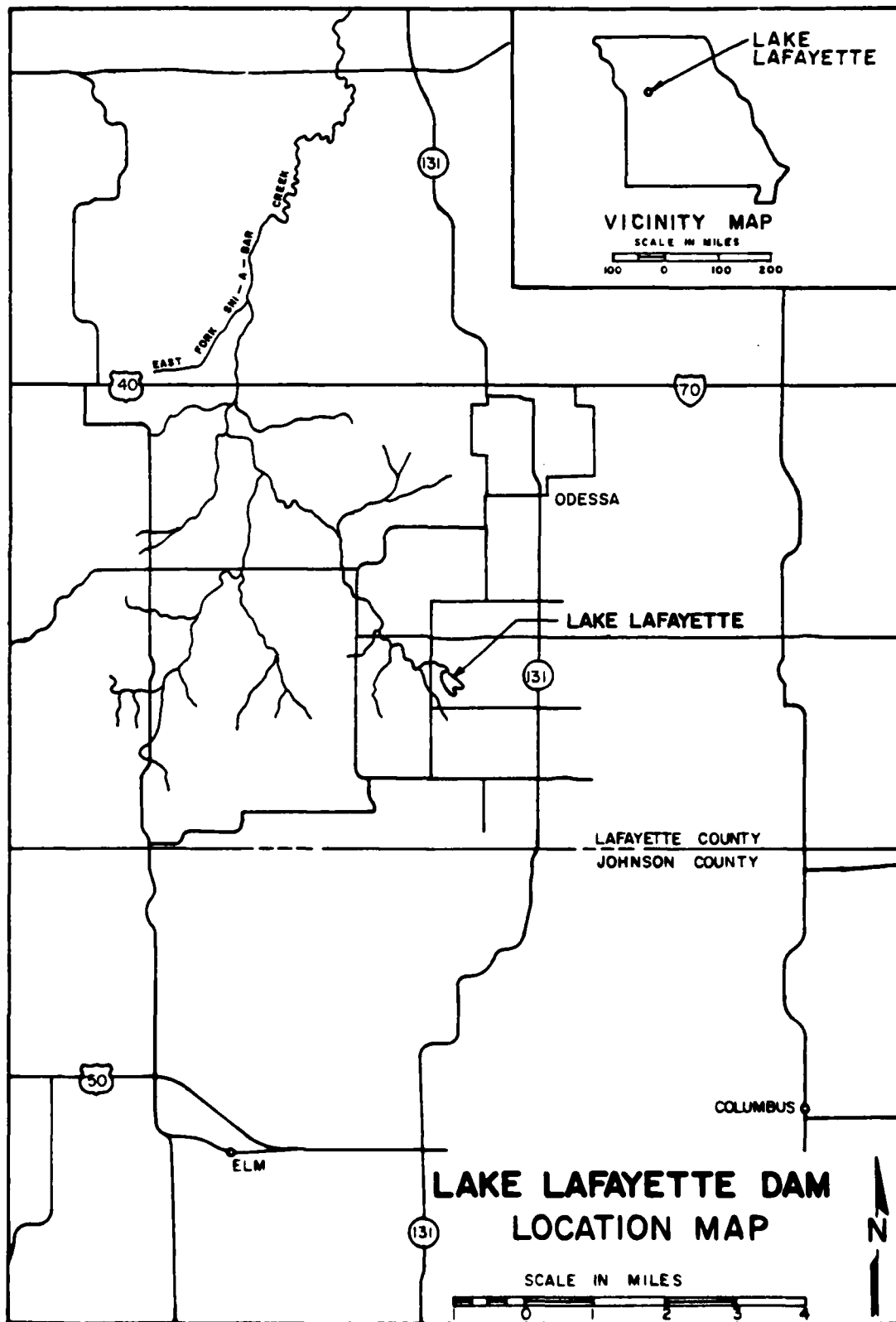
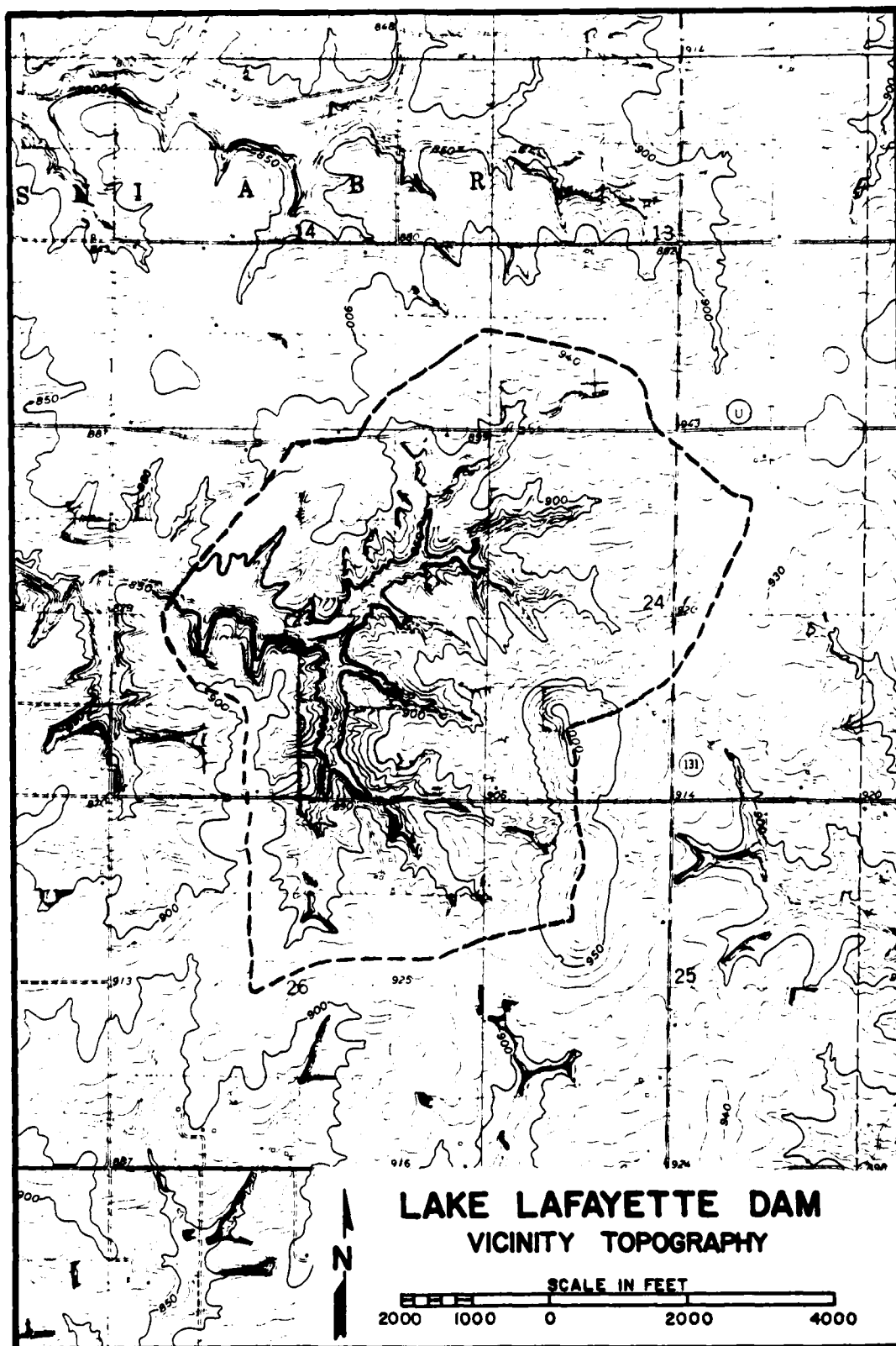
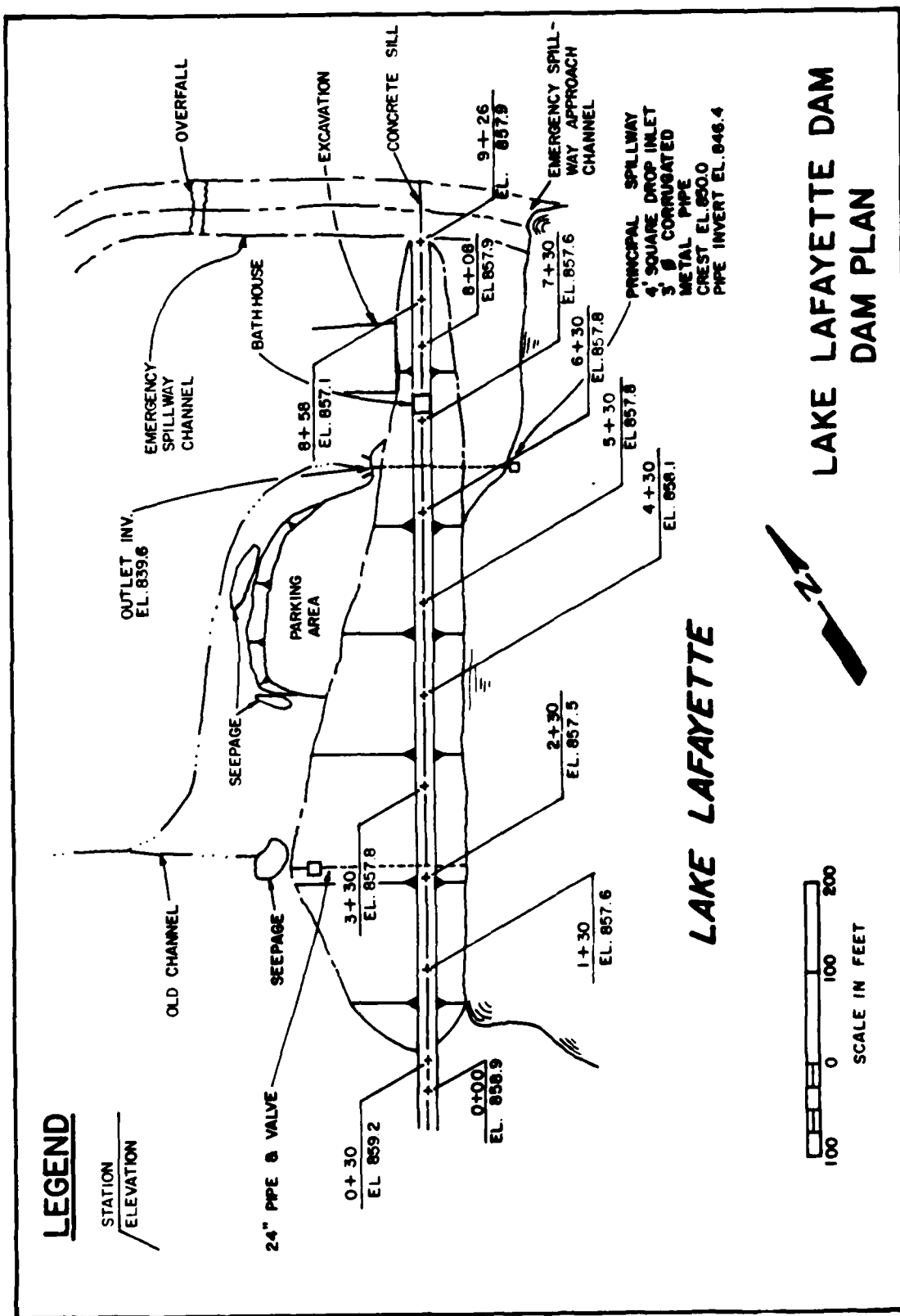
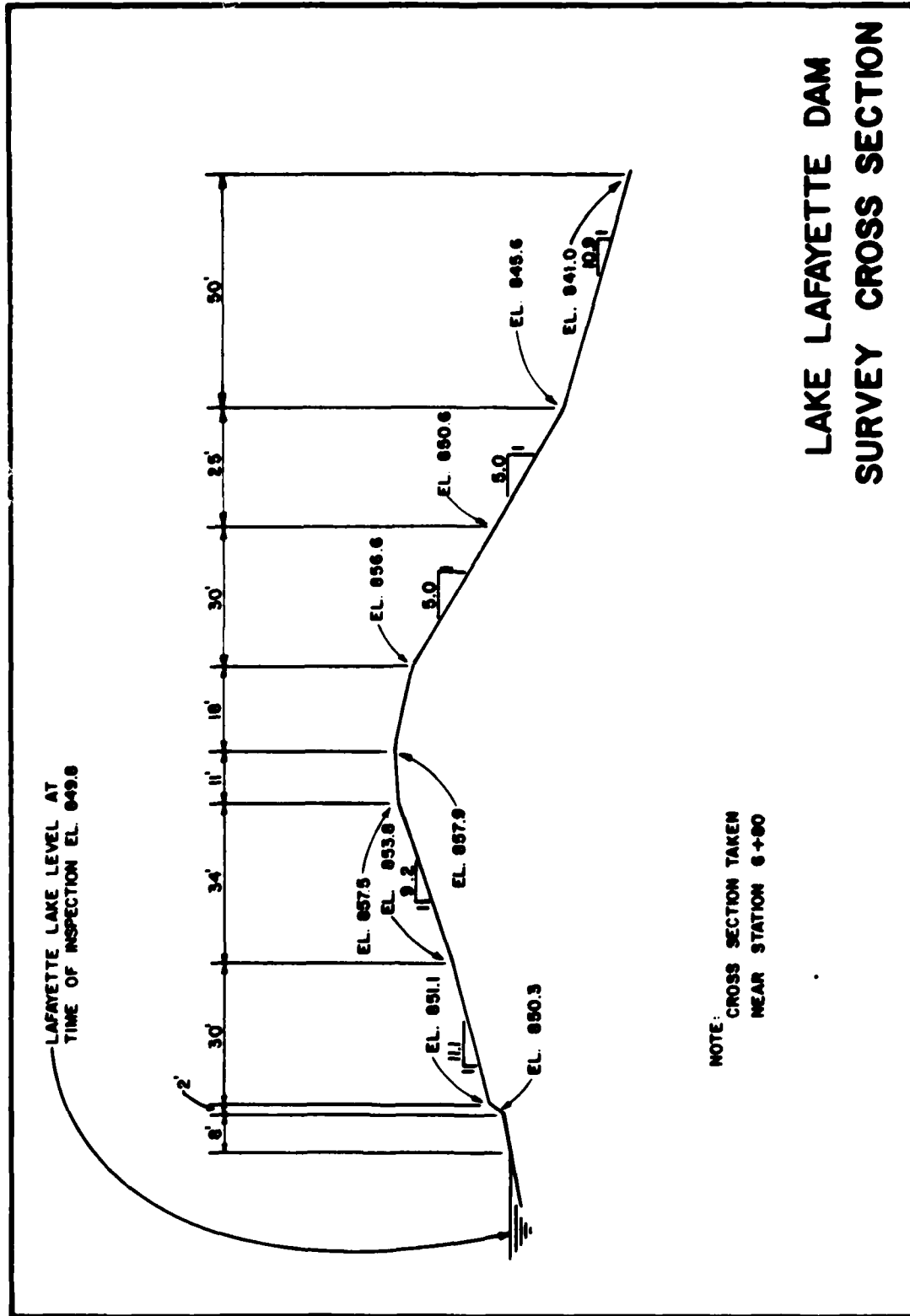


PLATE I



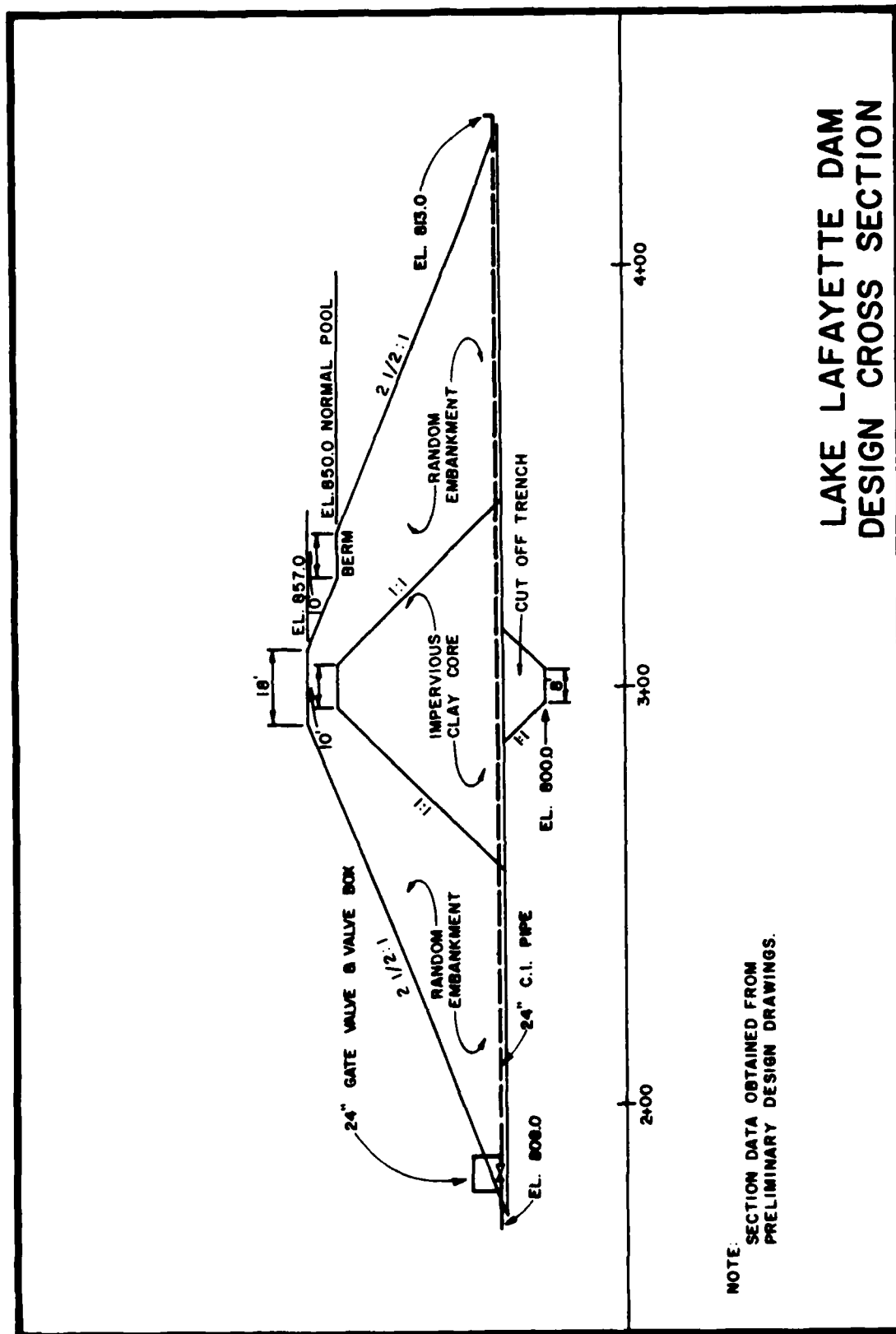
**PLATE 2**





# LAKE LAFAYETTE DAM SURVEY CROSS SECTION





NOTE: SECTION DATA OBTAINED FROM PRELIMINARY DESIGN DRAWINGS.

# LAKE LAFAYETTE DAM DESIGN CROSS SECTION

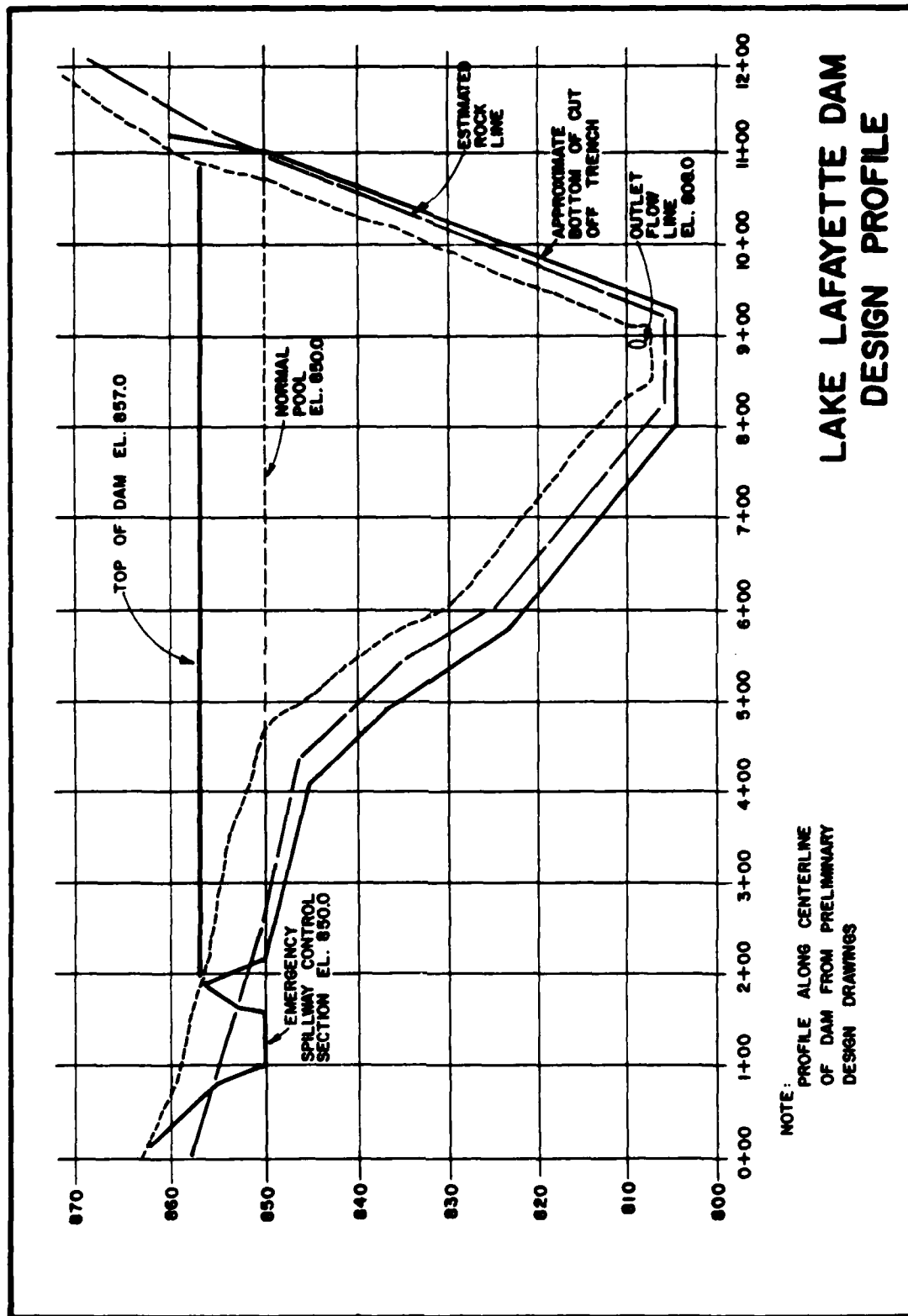
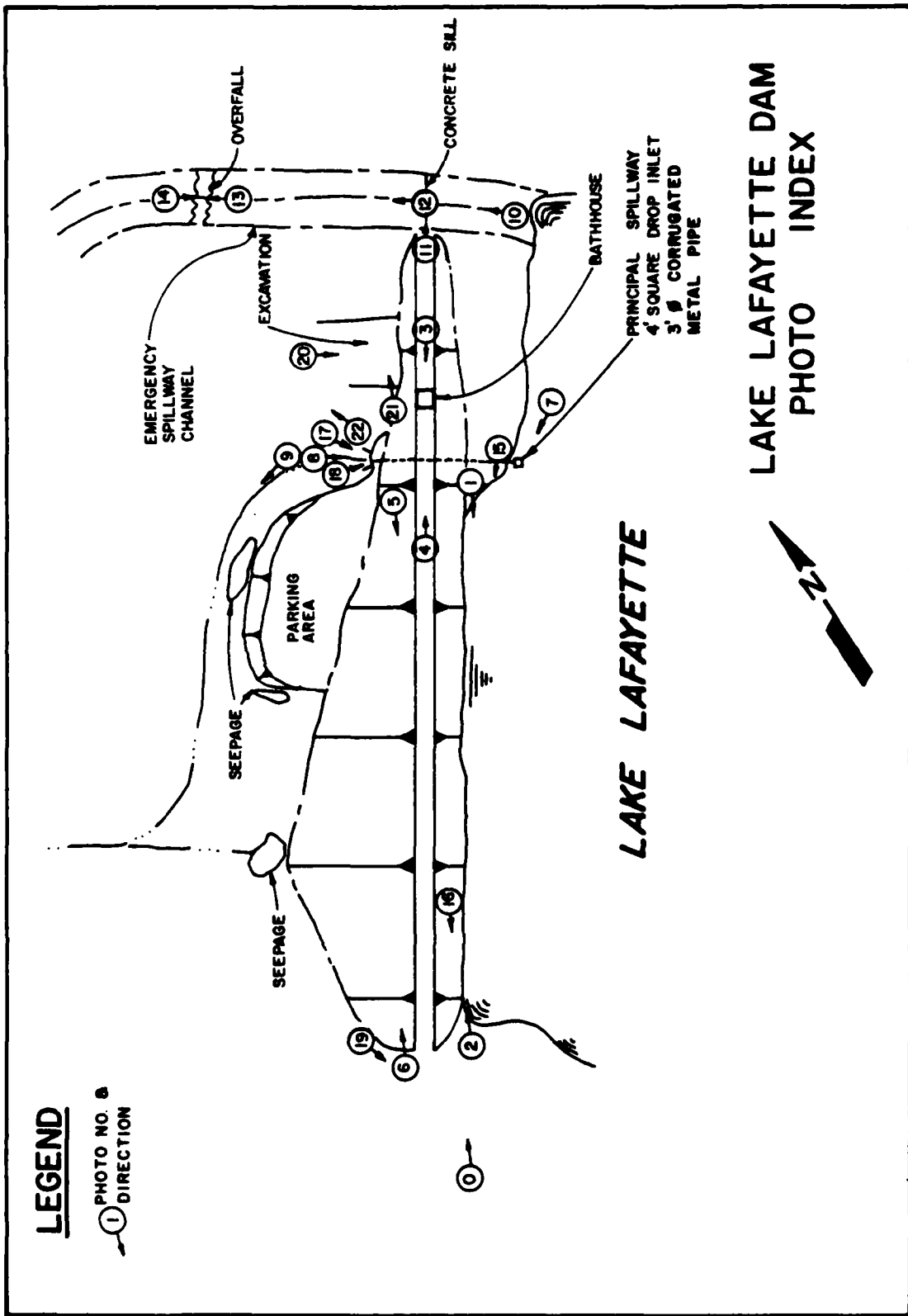


PLATE 6



LAKE LAFAYETTE DAM  
PHOTO INDEX





PHOTO 1: UPSTREAM FACE OF DAM LOOKING SOUTH



PHOTO 2: UPSTREAM FACE OF DAM LOOKING NORTH

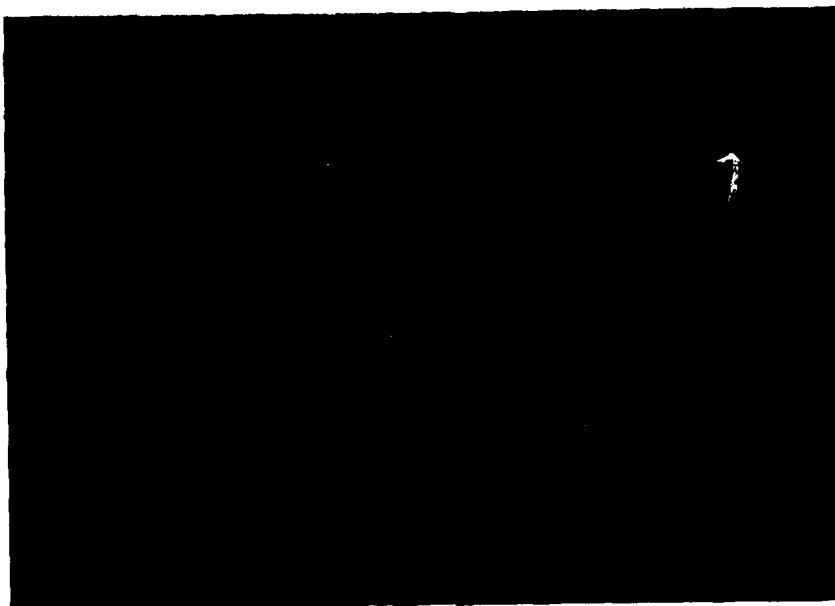


PHOTO 3: CREST OF DAM LOOKING SOUTH



PHOTO 4: CREST OF DAM LOOKING NORTH



PHOTO 5: DOWNSTREAM SLOPES OF DAM LOOKING SOUTH



PHOTO 6: DOWNSTREAM SLOPE OF DAM LOOKING NORTH



PHOTO 7: PRINCIPAL SPILLWAY DROP INLET



PHOTO 8: PRINCIPAL SPILLWAY PIPE OUTLET

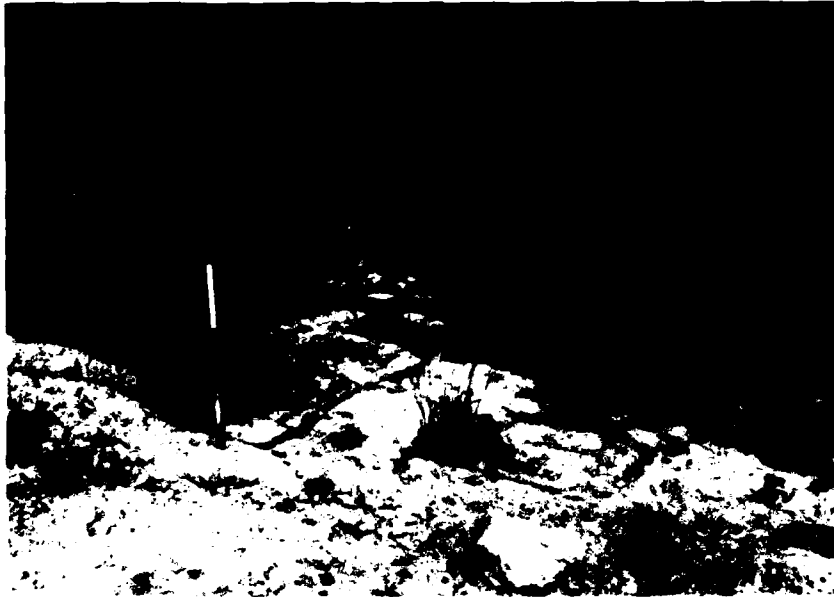


PHOTO 9: CHANNEL DOWNSTREAM OF PRINCIPAL SPILLWAY



PHOTO 10: EMERGENCY SPILLWAY LOOKING DOWNSTREAM FROM LAKE





PHOTO 11: EMERGENCY SPILLWAY CONTROL SILL

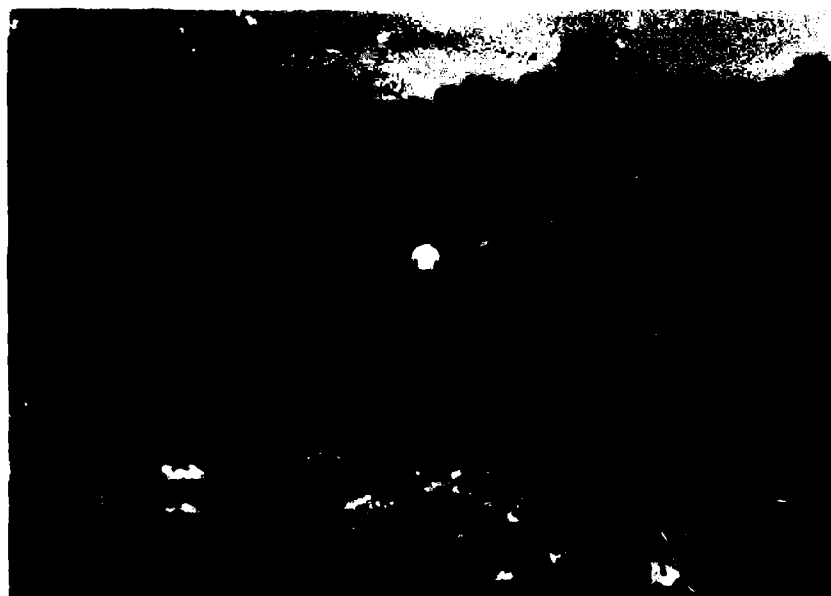


PHOTO 12: EMERGENCY SPILLWAY CHANNEL LOOKING DOWNSTREAM FROM  
CONTROL SILL



PHOTO 13: EMERGENCY SPILLWAY OVERFALL LOOKING DOWNSTREAM



PHOTO 14: EMERGENCY SPILLWAY OVERFALL LOOKING UPSTREAM



PHOTO 15: EROSION OF UPSTREAM FACE OF DAM AT SWIMMING AREA



PHOTO 16: EROSION PROTECTION ALONG UPSTREAM FACE OF DAM



PHOTO 17: PRINCIPAL SPILLWAY PIPE INTERIOR VIEWED FROM OUTLET



PHOTO 18: NEW BACKFILL AT PRINCIPAL SPILLWAY OUTLET HEADWALL

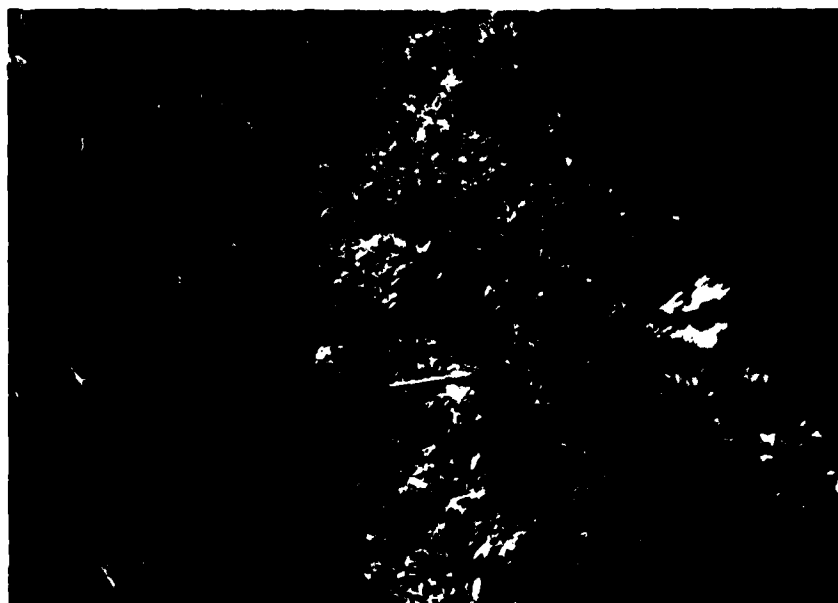


PHOTO 19: EROSION AT LEFT ABUTMENT-DOWNSTREAM SLOPE INTERFACE



PHOTO 20: NEW EXCAVATION AT RIGHT ABUTMENT VIEWED FROM DOWNSTREAM



PHOTO 21: EXCAVATION AT RIGHT ABUTMENT

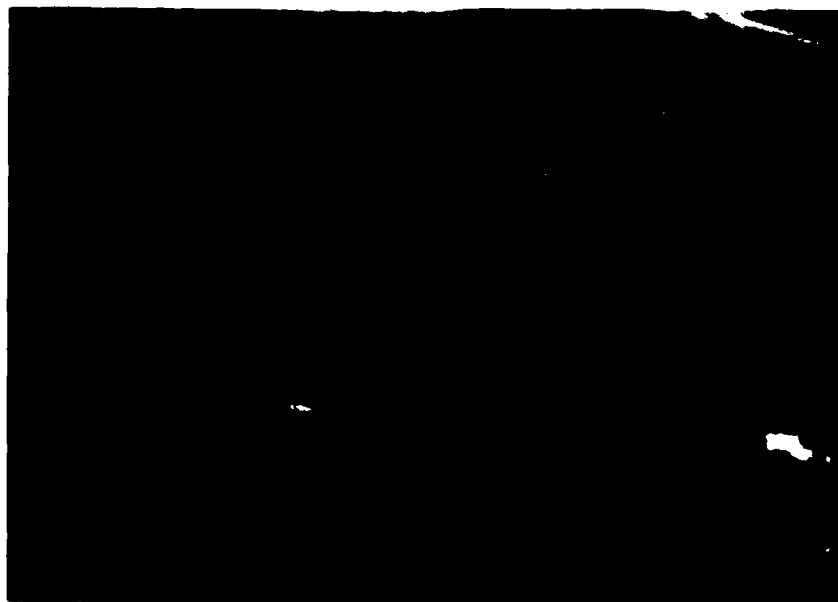


PHOTO 22: POSSIBLE SEEPAGE NEAR PRINCIPAL SPILLWAY OUTLET

**APPENDIX A**  
**HYDROLOGIC AND HYDRAULIC ANALYSES**

## HYDROLOGIC AND HYDRAULIC ANALYSES

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillways. The overtopping analysis was determined using the computer program HEC-1 (Dam Safety Version) (1).

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33" (HMR-33). Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm was determined according to the procedures outlined in HMR-33 and EM 1110-2-1411. The Kansas City, Missouri rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corp of Engineers, was used when the one percent chance probability flood was routed through the reservoir and spillways.

The synthetic unit hydrograph for the watershed was developed by the computer program using the Soil Conservation Service (SCS) method. The parameters for the unit hydrograph are shown in Table 1.

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2.

The reservoir routing was performed using the Modified Puls Method. The initial reservoir pool elevation for the routing of each storm was determined to be equivalent to the crest elevation of the principal spillway at elevation 850.0 feet m.s.l. in accordance with antecedent storm conditions preceding the one percent probability and probable maximum storms outlined by the U.S. Army Corps of Engineers, St. Louis District (2). The hydraulic capacity of the spillways and the storage capacity of the reservoir were defined by the elevation, surface area, storage, and discharge relationships shown in Table 3.

The rating curve for the spillways is shown in Table 4. The flow over the crest of the dam was determined using the nonlevel dam crest option (\$L and \$V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir. Discharge rates for the emergency spillway were determined by performing a backwater analysis of the emergency spillway channel using HEC-2 (3). The flow through the principal spillway was determined from the weir and orifice flow equations.

The result of the routing analyses indicates that 50 percent of the PMF will not overtop the dam.



A summary of the routing analysis for different ratios of the PMF is shown in Table 5.

The computer input data and a summary of the output data are presented at the back of this appendix.

TABLE 1  
SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	1.71 square miles	
Hydraulic Length of Watercourse ( )	3,900 feet	
Hydrologic Soil Cover Complex Number (CN')	89 (AMC III)	77 (AMC II)
Average Watershed Land Slope (Y)	2.4%	
Wave Velocity (V)	28 feet per second	
Length of Reservoir (L <sub>w</sub> )	4,900 feet	
Lag Time (L <sub>g</sub> )	0.47 hours (AMC III)	0.69 hours (AMC II)
Time of concentration (T <sub>c</sub> )	0.78 hours (AMC III)	1.15 hours (AMC II)
Duration (D)	6.2 min. (AMC III)	9.2 min. (AMC II)
	(use 5 minutes in each case)	

<u>Time (Min.) *</u>	<u>Discharge (cfs) *</u>	
	<u>AMC II</u>	<u>AMC III</u>
0	0	0
5	45	119
10	141	357
15	271	729
20	450	1198
25	679	1515
30	895	1611
35	1046	1559
40	1118	1384
45	1125	1153
50	1091	858
55	1007	639
60	910	489
65	789	383
70	639	295

\* From HEC-1 computer output

TABLE 1  
(Continued)

FORMULAS USED:

$$L_g = \frac{0.8 \times (S + 1)^{0.7}}{1,900 \times Y^{0.5}} \quad (4)$$

$$S = \frac{1000}{CN' - 10}$$

$$T_c = L_g / 0.6 + L_w / V$$

$$D = 0.133 T_c$$

TABLE 2  
RAINFALL-RUNOFF VALUES

<u>Selected Storm Event</u>	<u>Storm Duration (Hours)</u>	<u>Rainfall (Inches)</u>	<u>Runoff (Inches)</u>	<u>Loss (Inches)</u>
PMP	24	32.11	30.67	1.44
1% Probability	24	7.59	4.90	2.69

Additional Data:

- 1) The soil associations in this watershed are Macksburg, Higginsville, Kennebec, Leslie, Minden, Polo, Sampsel, Sogn, and Winfield (5).  
30 percent of drainage area in hydrologic soil group B.  
40 percent of drainage area in hydrologic soil group C.  
30 percent of drainage area in hydrologic soil group D.  
60 percent of the land use was grassland.  
15 percent of the land use was residential and roads.  
25 percent of the land use was timberland (4 and 6).
- 2) SCS Runoff Curve CN = 89 (AMC III) for the PMF.
- 3) SCS Runoff Curve CN = 77 (AMC II) for the one percent probability flood.

TABLE 3  
ELEVATION, SURFACE AREA, STORAGE, AND DISCHARGE RELATIONSHIPS

<u>Elevation (feet-MSL)</u>	<u>Lake Surface Area (acres)</u>	<u>Lake Storage (acre-ft)</u>	<u>Spillway Discharge (cfs)</u>
*850.0	74.3	1040	0
**850.4	75.9	1070	26
***857.1	102.9	1664	2987

\*Principal spillway crest elevation  
\*\*Emergency spillway crest elevation  
\*\*\*Top of dam elevation

The relationships in Table 3 were developed from the Odessa South, Missouri. 7.5 minute quadrangle map and the field measurements.

TABLE 4  
SPILLWAY RATING CURVE

<u>Reservoir Elevation (ft-msl)</u>	<u>Principal Spillway Discharge (cfs)</u>	<u>Emergency Spillway Discharge (cfs)</u>	<u>Total Spillway Discharges (cfs)</u>
*850.0	0	0	0
**850.4	26	0	26
852.0	67	200	267
854.0	73	1,000	1,073
856.0	78	2,200	2,278
***857.1	81	2,906	2,987

\*Principal Spillway Crest Elevation  
 \*\*Emergency Spillway Crest Elevation  
 \*\*\*Top of Dam Elevation

METHOD USED:

Principal spillway release rates were based on the discharge calculated for flow through the drop inlet and pipe using the orifice and weir equations. The minimum discharge of the two equations at a given water surface elevation was used for the spillway rating curve.

Orifice equation:

$$Q = Ca[2gH]^{1/2}$$

where:

C = 0.36 = coefficient of discharge  
 a = 7.07 sq. ft<sub>2</sub> = net area of orifice  
 g = 32.2 ft/sec<sup>2</sup> = gravitational acceleration  
 H = difference between the energy gradient elevation upstream and the downstream tailwater elevation (7).

Weir flow equation:

$$Q = CLH^{3/2}$$

where:

C = coefficient of discharge = 2.9 to 3.3  
 L = length of weir = 12 to 16 feet depending on H  
 H = head on the weir (7).

Emergency spillway release rates were determined by performing a back-water analysis of the emergency spillway channel using HEC.2 (3).

TABLE 5

RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (CFS)	Peak Lake Elevation (ft.-MSL)	Total Storage (AC.-FT.)	Peak Outflow (CFS)	Depth (ft.) Over Top of Dam
-	0	*850.0	1,040	0	-
0.50	6,224	856.8	1,629	2,765	0
1.00	12,447	859.4	1,909	9,739	2.3

\* Principal spillway crest elevation

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- (1) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, Davis, California.
- (2) U.S. Army Corps of Engineers, St. Louis District, Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams, 12 December 1979.
- (3) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Water Surface Profiles (HEC-2), March 13, 1980, Davis, California.
- (4) U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4. Hydrology, August 1972.
- (5) U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Lafayette County, Missouri.
- (6) U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 55, Urban Hydrology for Small Watersheds, January, 1975.
- (7) Horace W. King and Ernest F. Brater, Handbook of Hydraulics, Sixth Edition, McGraw Hill Book Company, 1976.
- (8) U.S. Department of Agriculture, Soil Conservation Service, Soil Survey Interpretations and Field Maps, 1980.
- (9) Mary H. McCracken, Missouri Division of Geological Survey, Geologic Map of Missouri, 1961.





FLOOD HYDROGRAPH PACKAGE (MEC-1)  
 BAS SAFETY VERSION JULY 1978  
 LAST MODIFICATION 06 FEB 80

MISSOURI DAM INSPECTIONS  
 LAKE LAFAYETTE DAM  
 FMI AND RATIOS

JOB SPECIFICATION  
 NO 268  
 JMR 5  
 JOPER 5  
 JMT 0  
 JRCPT 0  
 JTRCE 0  
 JSTAN 0

MULTI-PLAN ANALYSES TO BE PERFORMED  
 PLAN 1 NPLN= 7 LNTIO= 1  
 RTIOS= .50 .55 .60 .65 .70 .75 1.00

SUB-AREA RUNOFF COMPUTATION

COMPUTE INFLOW HYDROGRAPH  
 INSTAO 0  
 ICOMP 0  
 ITCOM 0  
 ITAPE 0  
 JPLT 0  
 JPRPT 0  
 INAME 1  
 ISTAGE 0  
 IZAUTO 0

HYDROGRAPH DATA  
 INVDG 1  
 IURG 2  
 TAREA 1.71  
 SNAP .90  
 TRSDA 1.71  
 TPSPC 1.00  
 RATIO .000  
 ISNCW 0  
 ISAPE 0  
 LOCAL 0

PRECIP DATA  
 SFFE .40  
 P45 24.70  
 P46 101.00  
 P47 120.00  
 P48 130.00  
 P49 .00  
 P50 .00  
 P51 .00  
 P52 .00  
 P53 .00  
 P54 .00  
 P55 .00  
 P56 .00  
 P57 .00  
 P58 .00  
 P59 .00  
 P60 .00

LUS DATA  
 LPOPT 0  
 STPAR 0  
 OLTER 0  
 RTIOL 1.00  
 ERARM .00  
 STAFFS .00  
 RTIOX 1.00  
 STIRL -1.00  
 CNSTL -89.00  
 ALSMR .03  
 RTIMP .00

CURVE NO 1 -69.00 WEINER 2 -1.00 EFFECT EN 89.00

UNIT HYDROGRAPH DATA  
 TC= .00  
 LAG= .47

RECUSSION DATA  
 STATUS= .00  
 RUCSNR .00  
 RTIOX= 1.00

UNIT HYDROGRAPH 30 END OF PERIOD ORIGINATES, TC= .47 VOL= 1.00 858.  
 110. 357. 729. 1192. 1515. 1611. 1559. 1324. 1153. 59.  
 630. 46. 27. 21. 15. 17. 10. 7. 6. 2.

112. 352. 720. 1180. 1515. 1611. 1550. 1384. 1152. 858.  
 630. 480. 340. 290. 220. 171. 112. 101. 7. 4. 59.  
 460. 350. 210. 150. 100. 100. 100. 100. 100. 100. 2.

| PCDA | HELM | PERIOD | FAIN | EXCS | LOSS | END-OF-PERIOD FLOW | COMP W | MOCCA | MRJMY | PERIOD | FAIN | EXCS | LOSS | COMP G |
|------|------|--------|------|------|------|--------------------|--------|-------|-------|--------|------|------|------|--------|
| 1.01 | 1.25 | 1      | .01  | .00  | .01  | 1.01               | 12.35  | 145   | 145   | 145    | .21  | .20  | .01  | 845.   |
| 1.01 | 1.10 | 2      | .01  | .00  | .01  | 1.01               | 12.14  | 144   | 144   | 144    | .21  | .20  | .01  | 855.   |
| 1.01 | 1.15 | 3      | .01  | .00  | .01  | 1.01               | 12.15  | 147   | 147   | 147    | .21  | .20  | .01  | 892.   |
| 1.01 | 1.20 | 4      | .01  | .00  | .01  | 1.01               | 12.20  | 148   | 148   | 148    | .21  | .20  | .01  | 1163.  |
| 1.01 | 1.25 | 5      | .01  | .00  | .01  | 1.01               | 12.25  | 149   | 149   | 149    | .21  | .20  | .01  | 1374.  |
| 1.01 | 1.30 | 6      | .01  | .00  | .01  | 1.01               | 12.30  | 150   | 150   | 150    | .21  | .20  | .01  | 1568.  |
| 1.01 | 1.35 | 7      | .01  | .00  | .01  | 1.01               | 12.35  | 151   | 151   | 151    | .21  | .20  | .00  | 1815.  |
| 1.01 | 1.40 | 8      | .01  | .00  | .01  | 1.01               | 12.40  | 152   | 152   | 152    | .21  | .20  | .00  | 2009.  |
| 1.01 | 1.45 | 9      | .01  | .00  | .01  | 1.01               | 12.45  | 153   | 153   | 153    | .21  | .20  | .00  | 2171.  |
| 1.01 | 1.50 | 10     | .01  | .00  | .01  | 1.01               | 12.50  | 154   | 154   | 154    | .21  | .20  | .00  | 2291.  |
| 1.01 | 1.55 | 11     | .01  | .00  | .01  | 1.01               | 12.55  | 155   | 155   | 155    | .21  | .20  | .00  | 2385.  |
| 1.01 | 1.60 | 12     | .01  | .00  | .01  | 1.01               | 13.00  | 156   | 156   | 156    | .21  | .20  | .00  | 2455.  |
| 1.01 | 1.65 | 13     | .01  | .00  | .01  | 1.01               | 13.05  | 157   | 157   | 157    | .25  | .25  | .00  | 2516.  |
| 1.01 | 1.70 | 14     | .01  | .00  | .01  | 1.01               | 13.10  | 158   | 158   | 158    | .25  | .25  | .00  | 2575.  |
| 1.01 | 1.75 | 15     | .01  | .00  | .01  | 1.01               | 13.15  | 159   | 159   | 159    | .25  | .25  | .00  | 2638.  |
| 1.01 | 1.80 | 16     | .01  | .00  | .01  | 1.01               | 13.20  | 160   | 160   | 160    | .25  | .25  | .00  | 2714.  |
| 1.01 | 1.85 | 17     | .01  | .00  | .01  | 1.01               | 13.25  | 161   | 161   | 161    | .25  | .25  | .00  | 2797.  |
| 1.01 | 1.90 | 18     | .01  | .00  | .01  | 1.01               | 13.30  | 162   | 162   | 162    | .25  | .25  | .00  | 2870.  |
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| 1.01 | 2.00 | 20     | .01  | .00  | .01  | 1.01               | 13.40  | 164   | 164   | 164    | .25  | .25  | .00  | 3024.  |
| 1.01 | 2.05 | 21     | .01  | .00  | .01  | 1.01               | 13.45  | 165   | 165   | 165    | .25  | .25  | .00  | 3100.  |
| 1.01 | 2.10 | 22     | .01  | .00  | .01  | 1.01               | 13.50  | 166   | 166   | 166    | .25  | .25  | .00  | 3178.  |
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| 1.01 | 2.30 | 26     | .01  | .00  | .01  | 1.01               | 14.10  | 170   | 170   | 170    | .31  | .31  | .00  | 3523.  |
| 1.01 | 2.35 | 27     | .01  | .00  | .01  | 1.01               | 14.15  | 171   | 171   | 171    | .31  | .31  | .00  | 3618.  |
| 1.01 | 2.40 | 28     | .01  | .00  | .01  | 1.01               | 14.20  | 172   | 172   | 172    | .31  | .31  | .00  | 3718.  |
| 1.01 | 2.45 | 29     | .01  | .00  | .01  | 1.01               | 14.25  | 173   | 173   | 173    | .31  | .31  | .00  | 3824.  |
| 1.01 | 2.50 | 30     | .01  | .00  | .01  | 1.01               | 14.30  | 174   | 174   | 174    | .31  | .31  | .00  | 3936.  |
| 1.01 | 2.55 | 31     | .01  | .00  | .01  | 1.01               | 14.35  | 175   | 175   | 175    | .31  | .31  | .00  | 4054.  |
| 1.01 | 2.60 | 32     | .01  | .00  | .01  | 1.01               | 14.40  | 176   | 176   | 176    | .31  | .31  | .00  | 4178.  |
| 1.01 | 2.65 | 33     | .01  | .00  | .01  | 1.01               | 14.45  | 177   | 177   | 177    | .31  | .31  | .00  | 4308.  |
| 1.01 | 2.70 | 34     | .01  | .00  | .01  | 1.01               | 14.50  | 178   | 178   | 178    | .31  | .31  | .00  | 4444.  |
| 1.01 | 2.75 | 35     | .01  | .00  | .01  | 1.01               | 14.55  | 179   | 179   | 179    | .31  | .31  | .00  | 4586.  |
| 1.01 | 2.80 | 36     | .01  | .00  | .01  | 1.01               | 15.00  | 180   | 180   | 180    | .31  | .31  | .00  | 4734.  |
| 1.01 | 2.85 | 37     | .01  | .00  | .01  | 1.01               | 15.05  | 181   | 181   | 181    | .38  | .38  | .00  | 4888.  |
| 1.01 | 2.90 | 38     | .01  | .00  | .01  | 1.01               | 15.10  | 182   | 182   | 182    | .38  | .38  | .00  | 5048.  |
| 1.01 | 2.95 | 39     | .01  | .00  | .01  | 1.01               | 15.15  | 183   | 183   | 183    | .38  | .38  | .00  | 5214.  |
| 1.01 | 3.00 | 40     | .01  | .00  | .01  | 1.01               | 15.20  | 184   | 184   | 184    | .57  | .57  | .00  | 5386.  |
| 1.01 | 3.05 | 41     | .01  | .00  | .01  | 1.01               | 15.25  | 185   | 185   | 185    | .66  | .66  | .00  | 5564.  |
| 1.01 | 3.10 | 42     | .01  | .00  | .01  | 1.01               | 15.30  | 186   | 186   | 186    | 1.01 | 1.00 | .01  | 5748.  |
| 1.01 | 3.15 | 43     | .01  | .00  | .01  | 1.01               | 15.35  | 187   | 187   | 187    | 2.65 | 2.65 | .01  | 5938.  |
| 1.01 | 3.20 | 44     | .01  | .00  | .01  | 1.01               | 15.40  | 188   | 188   | 188    | 1.04 | 1.04 | .00  | 6134.  |
| 1.01 | 3.25 | 45     | .01  | .00  | .01  | 1.01               | 15.45  | 189   | 189   | 189    | .64  | .64  | .00  | 6336.  |
| 1.01 | 3.30 | 46     | .01  | .00  | .01  | 1.01               | 15.50  | 190   | 190   | 190    | .57  | .57  | .00  | 6544.  |
| 1.01 | 3.35 | 47     | .01  | .00  | .01  | 1.01               | 15.55  | 191   | 191   | 191    | .38  | .38  | .00  | 6758.  |
| 1.01 | 3.40 | 48     | .01  | .00  | .01  | 1.01               | 16.00  | 192   | 192   | 192    | .38  | .38  | .00  | 6978.  |
| 1.01 | 3.45 | 49     | .01  | .00  | .01  | 1.01               | 16.05  | 193   | 193   | 193    | .29  | .29  | .00  | 7204.  |
| 1.01 | 3.50 | 50     | .01  | .00  | .01  | 1.01               | 16.10  | 194   | 194   | 194    | .29  | .29  | .00  | 7436.  |
| 1.01 | 3.55 | 51     | .01  | .00  | .01  | 1.01               | 16.15  | 195   | 195   | 195    | .29  | .29  | .00  | 7674.  |
| 1.01 | 3.60 | 52     | .01  | .00  | .01  | 1.01               | 16.20  | 196   | 196   | 196    | .29  | .29  | .00  | 7918.  |
| 1.01 | 3.65 | 53     | .01  | .00  | .01  | 1.01               | 16.25  | 197   | 197   | 197    | .29  | .29  | .00  | 8168.  |

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B L A C K  &  V E A T C H
=====
PROJECT 9166.          DATE  7 AUG 80      PAGE   6
=====
PROGRAM N21/2-DU      TIME 03:49:21      CASE
=====
FLC00 MIDCOMPM PACKAGE - MEC-1
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|      |       |     |     |     |     |      |      |       |     |     |     |     |      |
|------|-------|-----|-----|-----|-----|------|------|-------|-----|-----|-----|-----|------|
| 1.01 | 9.10  | 117 | .07 | .06 | .01 | 778. | 1.01 | 21.10 | 254 | .02 | .02 | .00 | 272. |
| 1.01 | 9.15  | 111 | .07 | .06 | .00 | 760. | 1.01 | 21.15 | 255 | .02 | .02 | .00 | 272. |
| 1.01 | 9.20  | 112 | .07 | .06 | .00 | 767. | 1.01 | 21.20 | 254 | .02 | .02 | .00 | 272. |
| 1.01 | 9.25  | 119 | .07 | .06 | .00 | 786. | 1.01 | 21.25 | 257 | .02 | .02 | .00 | 272. |
| 1.01 | 9.30  | 114 | .07 | .06 | .00 | 768. | 1.01 | 21.30 | 259 | .02 | .02 | .00 | 272. |
| 1.01 | 9.35  | 115 | .07 | .06 | .00 | 750. | 1.01 | 21.35 | 259 | .02 | .02 | .00 | 272. |
| 1.01 | 9.40  | 116 | .07 | .06 | .00 | 742. | 1.01 | 21.40 | 260 | .02 | .02 | .00 | 272. |
| 1.01 | 9.45  | 117 | .07 | .06 | .00 | 795. | 1.01 | 21.45 | 261 | .02 | .02 | .00 | 272. |
| 1.01 | 9.50  | 112 | .07 | .06 | .00 | 797. | 1.01 | 21.50 | 262 | .02 | .02 | .00 | 272. |
| 1.01 | 9.55  | 119 | .07 | .06 | .00 | 798. | 1.01 | 21.55 | 263 | .02 | .02 | .00 | 272. |
| 1.01 | 10.00 | 120 | .07 | .06 | .00 | 800. | 1.01 | 22.00 | 264 | .02 | .02 | .00 | 272. |
| 1.01 | 10.05 | 121 | .07 | .06 | .00 | 802. | 1.01 | 22.05 | 265 | .02 | .02 | .00 | 272. |
| 1.01 | 10.10 | 122 | .07 | .06 | .00 | 804. | 1.01 | 22.10 | 266 | .02 | .02 | .00 | 272. |
| 1.01 | 10.15 | 123 | .07 | .06 | .00 | 805. | 1.01 | 22.15 | 267 | .02 | .02 | .00 | 272. |
| 1.01 | 10.20 | 124 | .07 | .06 | .00 | 807. | 1.01 | 22.20 | 269 | .02 | .02 | .00 | 272. |
| 1.01 | 10.25 | 125 | .07 | .06 | .00 | 808. | 1.01 | 22.25 | 269 | .02 | .02 | .00 | 272. |
| 1.01 | 10.30 | 126 | .07 | .06 | .00 | 810. | 1.01 | 22.30 | 270 | .02 | .02 | .00 | 272. |
| 1.01 | 10.35 | 127 | .07 | .06 | .00 | 811. | 1.01 | 22.35 | 271 | .02 | .02 | .00 | 272. |
| 1.01 | 10.40 | 128 | .07 | .06 | .00 | 812. | 1.01 | 22.40 | 272 | .02 | .02 | .00 | 272. |
| 1.01 | 10.45 | 129 | .07 | .06 | .00 | 814. | 1.01 | 22.45 | 273 | .02 | .02 | .00 | 272. |
| 1.01 | 10.50 | 130 | .07 | .06 | .00 | 815. | 1.01 | 22.50 | 274 | .02 | .02 | .00 | 272. |
| 1.01 | 10.55 | 131 | .07 | .06 | .00 | 816. | 1.01 | 22.55 | 275 | .02 | .02 | .00 | 272. |
| 1.01 | 11.00 | 132 | .07 | .06 | .00 | 817. | 1.01 | 23.00 | 275 | .02 | .02 | .00 | 272. |
| 1.01 | 11.05 | 133 | .07 | .06 | .00 | 818. | 1.01 | 23.05 | 277 | .02 | .02 | .00 | 272. |
| 1.01 | 11.10 | 134 | .07 | .06 | .00 | 819. | 1.01 | 23.10 | 278 | .02 | .02 | .00 | 272. |
| 1.01 | 11.15 | 135 | .07 | .06 | .00 | 820. | 1.01 | 23.15 | 279 | .02 | .02 | .00 | 272. |
| 1.01 | 11.20 | 136 | .07 | .06 | .00 | 821. | 1.01 | 23.20 | 280 | .02 | .02 | .00 | 272. |
| 1.01 | 11.25 | 137 | .07 | .06 | .00 | 822. | 1.01 | 23.25 | 281 | .02 | .02 | .00 | 272. |
| 1.01 | 11.30 | 138 | .07 | .06 | .00 | 823. | 1.01 | 23.30 | 282 | .02 | .02 | .00 | 272. |
| 1.01 | 11.35 | 139 | .07 | .06 | .00 | 824. | 1.01 | 23.35 | 284 | .02 | .02 | .00 | 272. |
| 1.01 | 11.40 | 140 | .07 | .06 | .00 | 825. | 1.01 | 23.40 | 284 | .02 | .02 | .00 | 272. |
| 1.01 | 11.45 | 141 | .07 | .06 | .00 | 826. | 1.01 | 23.45 | 285 | .02 | .02 | .00 | 272. |
| 1.01 | 11.50 | 142 | .07 | .06 | .00 | 827. | 1.01 | 23.50 | 286 | .02 | .02 | .00 | 272. |
| 1.01 | 11.55 | 143 | .07 | .06 | .00 | 827. | 1.01 | 23.55 | 287 | .02 | .02 | .00 | 272. |
| 1.01 | 12.00 | 144 | .07 | .06 | .00 | 828. | 1.02 | 24.00 | 289 | .02 | .02 | .00 | 272. |

50 = 32.11 50.07 1.44 40479.0  
( 816.11 77.01 30.111462.20)

# HYDROGRAPH AT STA HEAD FOR PLAN 1, RTIO 6

PERC 0-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

PLACE & VELOCITY  
FLOOD HYDROGRAPH PACKAGE - HEC-1  
PROJECT 9100, DATE 7 AUG 80 PAGE 9  
PERFORMED BY: JAC time 13:48:12 CASE

|            |        |        |        |        |        |
|------------|--------|--------|--------|--------|--------|
| CFS        | 9375   | 2342   | 1012   | 1057   | 12955  |
| CM3        | 264    | 65     | 25     | 30     | 9375   |
| INCHES     | 17.79  | 22.54  | 22.87  | 24.80  | 24.80  |
| MM         | 461.77 | 569.61 | 569.61 | 569.61 | 569.61 |
| AC-FT      | 1457   | 2014   | 2014   | 2014   | 2014   |
| THOUS CU M | 2046   | 2874   | 2874   | 2874   | 2874   |

## HYDROGRAPH AT STA HEAD FOR PLAN 1, RTIO 7

|            |        |         |         |              |
|------------|--------|---------|---------|--------------|
| PEAK       | 8-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| 12627      | 4650   | 1637    | 1637    | 40364        |
| CFS        | 350    | 126     | 47      | 19436        |
| CM3        | 26     | 30      | 10      | 10032        |
| INCHES     | 44.26  | 50.52   | 30.47   | 275.24       |
| MM         | 615.70 | 778.21  | 775.2   | 775.2        |
| AC-FT      | 2213   | 2725    | 2725    | 2725         |
| THOUS CU M | 2725   | 3632    | 3632    | 3632         |

## HYDROGRAPH INPUTS

### ROUTE HYDROGRAPH THROUGH DAM

|              |        |        |        |         |         |         |         |         |
|--------------|--------|--------|--------|---------|---------|---------|---------|---------|
| STAG         | ICOP   | ISCU   | ISARE  | JUL     | JPT     | ISARE   | ISTAGE  | IAUTO   |
| 0            | 1      | 0      | 0      | 0       | 0       | 1       | 0       | 0       |
| LOSS         | CLOSS  | AVG    | IPES   | ISARE   | IPMP    | LSIR    |         |         |
| 0            | 0      | 0      | 1      | 0       | 0       | 0       |         |         |
| ASTPS        | INSTOL | LAG    | APSPR  | APCO    | APCO    | STORA   | IPMPRT  |         |
| 0            | 0      | 0      | 0      | 0       | 0       | 0       | 0       |         |
| SCALE        | 853.00 | 851.00 | 852.00 | 854.00  | 855.00  | 857.00  | 858.00  | 863.00  |
| PLW          | 0.00   | 02.20  | 267.09 | 1070.00 | 2280.00 | 2470.00 | 3580.00 | 4000.00 |
| SURFACE AREA | 0      | 70     | 115    | 171     | 240     |         |         |         |
| CAPACITY     | 3      | 1040   | 1077   | 1308    | 1640    |         |         |         |
| ELEVATION    | 607    | 650    | 660    | 670     | 680     |         |         |         |
| CHAL         | SPHIC  | LOW    | UPH    | UPH     | UPH     | UPH     | UPH     | UPH     |
| 0            | 0      | 0      | 0      | 0       | 0       | 0       | 0       | 0       |

### RAW DATA

|              |      |      |      |      |      |      |      |      |
|--------------|------|------|------|------|------|------|------|------|
| TOPIC        | COEF | TRIP | TRIP | TRIP | TRIP | TRIP | TRIP | TRIP |
| 857.4        | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| CRIST LENGTH | 3    | 78   | 105  | 130  | 170  | 200  | 213  | 218  |

[illegible]

100-443887-100

[illegible]

P L A N 3 V E R Y C M  
 FLOOD HYDROGRAPH PACKAGE - HFC-1  
 PROJECT 0150. DATE 7 AUG 83 PAGE 24  
 PROGRAM M2102-GU TIME 13:00:31 CASE

PEAK FLOW AND STORAGE (EAD OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND (CFS) (METERS PER SECOND)  
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

| OPERATION     | STATION | AREA  | PLAN | RATIO 1 | RATIO 2   | RATIOS APPLIED TO FLOW |           |           |           |           |  |  |
|---------------|---------|-------|------|---------|-----------|------------------------|-----------|-----------|-----------|-----------|--|--|
|               |         |       |      |         |           | RATIO 3                | RATIO 4   | RATIO 5   | RATIO 6   | RATIO 7   |  |  |
|               |         |       |      | .50     | .55       | .60                    | .65       | .70       | .75       | 1.00      |  |  |
| HYDROGRAPH AT | HEAD    | 1.27  | 1    | 6226.   | 6860.     | 7498.                  | 8091.     | 8713.     | 9335.     | 12447.    |  |  |
|               | (       | 4.43) | (    | 176.23) | ( 193.86) | ( 211.48)              | ( 229.10) | ( 246.73) | ( 264.35) | ( 332.67) |  |  |
| ROUTED TO     | FW      | 1.27  | 1    | 2765.   | 3060.     | 3418.                  | 3909.     | 4789.     | 5022.     | 9739.     |  |  |
|               | (       | 4.43) | (    | 76.50)  | ( 86.81)  | ( 96.03)               | ( 113.25) | ( 135.62) | ( 159.20) | ( 275.79) |  |  |

BLACK B V E A T I M  
 FLOOD INTERGRAPH PACKAGE - MFC-1

SUMMARY OF DAM SAFETY ANALYSIS

| PLAN 1 .....       | ELEVATION<br>STORAGE<br>OUTFLOW              | INITIAL VALUE<br>PSI-00<br>10.00<br>0. | SPILLWAY CREST<br>PSI-00<br>104.0<br>104.0 | TOP OF DAM<br>PSI-10<br>176.1<br>260.7 |                                 |                             |
|--------------------|--|--|--|--|---------------------------------|-----------------------------|
| RATIO<br>OF<br>P-1 | MAXIMUM<br>RESERVOIR<br>ELEVATION<br>PSI-11V | MAXIMUM<br>STORAGE<br>AC-FT            | MAXIMUM<br>OUTFLOW<br>CFS                  | DURATION<br>OVER TOP<br>HOURS          | TIME OF<br>MAX OUTFLOW<br>HOURS | TYPE OF<br>FAILURE<br>HOURS |
| .50                | 500.70                                       | 1529.                                  | 2763.                                      | .00                                    | 16.75                           | .00                         |
| .55                | 517.21                                       | 1675.                                  | 3046.                                      | .67                                    | 15.67                           | .00                         |
| .60                | 537.45                                       | 1720.                                  | 3478.                                      | 1.50                                   | 16.67                           | .00                         |
| .65                | 558.21                                       | 1758.                                  | 3769.                                      | 1.62                                   | 16.56                           | .00                         |
| .70                | 578.29                                       | 1788.                                  | 4786.                                      | 2.25                                   | 16.50                           | .00                         |
| .75                | 598.52                                       | 1831.                                  | 5622.                                      | 2.50                                   | 16.50                           | .00                         |
| 1.00               | 659.39                                       | 1900.                                  | 6730.                                      | 3.17                                   | 16.53                           | .00                         |



**APPENDIX B**

**INSPECTION REPORT  
MO. DEPT NATURAL RESOURCES**

ADDENDUM TO LAKE LAFAYETTE

LAFAYETTE COUNTY

The dam was visited on 18 April 1979. The embankment portion of the dam showed no evidence of instability. It has been built mostly of modified loess (CL) material. No leakage of significance was evident at either abutment or toe.

The emergency spillway was beginning to erode severely both in the loess as well as the thin limestone (1-2 foot thick) and shale beds underlying the loess. The outlet portion of the primary spillway was also beginning to erode badly. The spillway discharged onto the silty clay (CL) soil. This primary spillway is a 3 foot concrete box drop inlet discharging to an 18 inch (?) cnp.

Dr. J. Hadley Williams, Chief  
Engineering Geology Section  
Geology & Land Survey  
April 19, 1979

END

DATE  
FILMED

11-81

DTIC